

What is claimed is:

1. A method of measuring extent and severity of disease in a patient, comprising the steps of:

- (a) acquiring a first anatomical image data set and a first functional image data set of the patient, said first anatomical image data set and said first functional image data set form a first co-registered composite image data set;
- (b) identifying at least a volume of interest (VOI) within said first co-registered composite image data set;
- (c) qualitatively and quantitatively analyzing said first co-registered composite image data set including said VOI to determine extent and severity of the disease;
- (d) acquiring a second anatomical image data set and a second functional image data set of the patient, said second anatomical image data set and said second functional image data set form a second co-registered composite image data set;
- (e) performing a global, rigid registration of said first anatomical image data set and said second anatomical image data set, such that said first functional image data set and said second functional image data set are also globally registered;
- (f) identifying at least a VOI within the globally registered image data set using the identified VOI within said first co-registered composite image data set;
- (g) performing a local, non-rigid registration of said VOI within said first co-registered composite image data set and said VOI within the globally registered image data set, thereby producing a first co-registered serial image data set, said local, non-rigid registration being more precise than said global, rigid registration; and
- (h) qualitatively and quantitatively analyzing said first co-registered serial image data set including the VOIs to determine severity of the disease and/or response to treatment of the patient.

2. The method of claim 1, further comprising the step of (i) performing a final local, non-rigid registration of the image data sets, wherein steps (g) and (i) have varying degrees therebetween.

5 3. The method of claim 1, wherein, in steps (b) and (f), the VOIs are selected from a subset of said anatomical image data sets.

 4. The method of claim 1, wherein, in steps (b) and (f), the VOIs are selected from a subset of said functional image data sets.

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 5. The method of claim 1, wherein, in steps (b) and (f), the VOIs are selected from a subset of said anatomical image data sets and a subset of said functional image data sets.

15 6. The method of claim 1, wherein said first anatomical image data set and said first functional image data set are acquired before treatment of the patient, and said second anatomical image data set and said second functional image data set are acquired during treatment of the patient.

20 7. The method of claim 1, wherein said first anatomical image data set and said first functional image data set are acquired before treatment of the patient, and said second anatomical image data set and said second functional image data set are acquired after treatment of the patient.

25 8. The method of claim 1, wherein said first anatomical image data set and said first functional image data set are acquired during treatment of the patient, and said second anatomical image data set and said second functional image data set are acquired after treatment of the patient.

30 9. The method of claim 1, wherein the qualitative analysis includes determining at least one of a presence, absence and location of the disease, and number of tumors.

10. The method of claim 1, wherein the quantitative analysis includes determining at least one of a means, deviation, size and shape of the disease in the functional image data sets.

5 11. The method of claim 1, wherein the quantitative analysis includes determining at least one of a texture, size and shape of disease in the anatomical image data sets.

12. The method of claim 1, wherein said global, rigid registration
10 includes rigid matching of the anatomy of the patient.

13. The method of claim 1, wherein said local, non-rigid registration includes local matching of surrounding tissues, anatomy and/or function of the patient.

15 14. A system for measuring extent and severity of disease in a patient, comprising:

 imaging device for acquiring a plurality of anatomical image data sets and a plurality of functional image data sets of the patient, said plurality of anatomical image data sets and said plurality of functional image data sets
20 form a plurality of co-registered composite image data sets;

 a user device for identifying at least a volume of interest (VOI) within a co-registered composite image data set of said plurality of co-registered composite image data sets, and identifying at least a VOI within a globally registered image data set of a plurality of globally registered image data sets
25 using the identified VOI within said co-registered composite image data set; and

 a computer system for performing the following steps:
 qualitatively and quantitatively analyzing a first co-registered composite image data set of said plurality of co-registered composite
30 image data sets including the identified VOI to determine extent and severity of the disease;
 performing a global, rigid registration of a first anatomical image data set and a second anatomical image data set of said plurality of

anatomical image data sets, such that a first functional image data set and a second functional image data set of said plurality of functional image data sets are also globally registered;

5 performing a local, non-rigid registration of the VOI within said first co-registered composite image data set and the VOI within the globally registered image data set, thereby producing a first co-registered serial image data set, said local, non-rigid registration being more precise than said global, rigid registration; and

10 qualitatively and quantitatively analyzing said first co-registered serial image data set including the VOIs to determine severity of the disease and/or response to treatment of the patient.

15 15. The system of claim 14, wherein said imaging device includes a computed tomography (CT) scanner and a single photon emission computed tomography (SPECT) scanner.

20 16. The system of claim 15, wherein said CT scanner is housed in a single CT gantry, and said SPECT scanner is housed in a single SPECT gantry.

17. The system of claim 16, wherein a single patient bed is movable between said CT gantry and said SPECT gantry.

25 18. The system of claim 16, wherein said CT scanner and said SPECT scanner is housed in a combined CT and SPECT gantry.

19. The system of claim 18, wherein a single patient bed is movable between said CT and SPECT gantry.

30 20. The system of claim 14, wherein said first anatomical image data set and said first functional image data set are acquired before treatment of the patient, and said second anatomical image data set and said second functional image data set are acquired during treatment of the patient.

21. The system of claim 14, wherein said first anatomical image data set and said first functional image data set are acquired before treatment of the patient, and said second anatomical image data set and said second functional
5 image data set are acquired after treatment of the patient.

22. The system of claim 14, wherein said first anatomical image data set and said first functional image data set are acquired during treatment of the patient, and said second anatomical image data set and said second functional
10 image data set are acquired after treatment of the patient.

23. The system of claim 14, wherein said global, rigid registration includes rigid matching of the anatomy of the patient.

15 24. The system of claim 14, wherein said local, non-rigid registration includes local matching of surrounding tissues, anatomy and/or function of the patient.

25 25. The system of claim 14, wherein said imaging device includes a computed tomography (CT) scanner and a positron emission tomography (PET) scanner.

26. The system of claim 25, wherein said CT scanner is housed in a single CT gantry, and said PET scanner is housed in a single PET gantry.
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27. The system of claim 26, wherein a single patient bed is movable between said CT gantry and said PET gantry.

28. The system of claim 26, wherein said CT scanner and said PET scanner is housed in a combined CT and PET gantry.
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29. The system of claim 28, wherein a single patient bed is movable between said CT and PET gantry.

30. The system of claim 14, wherein said imaging device includes at least one of a computed tomography (CT) scanner, ultrasound imaging scanner, fluoroscopy scanner and magnetic resonance imaging (MRI) scanner providing said anatomical image data set, and at least one of a gamma camera,
5 positron emission tomography (PET) scanner and single photon emission computer tomography (SPECT) scanner providing said functional image data set.

31. The system of claim 14, wherein said imaging device is a single
10 scanner capable of acquiring both said anatomical image data sets and said functional image data sets.

32. The system of claim 14, wherein said system further comprises an output device for printing reports, images, and the various image data sets.
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33. The system of claim 14, wherein said user device comprises a display unit for displaying the various image data sets, and an input device for selecting said VOI within the various image data sets.

20 34. The system of claim 14, wherein said computer system comprises a storage means for storing the various image data sets.

35. The system of claim 14, wherein said computer system further performs the step of performing a final local, non-rigid registration of the image
25 data sets, wherein the local registration steps have varying degrees therebetween.

36. The system of claim 14, wherein, the VOIs are selected from a subset of said anatomical image data sets.
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37. The system of claim 14, wherein the VOIs are selected from a subset of said functional image data sets.

38. The system of claim 14, wherein the VOIs are selected from a subset of said anatomical image data sets and a subset of said functional image data sets.

5 39. The system of claim 14, wherein the qualitative analysis includes determining at least one of a presence, absence and location of the disease, and number of tumors.

10 40. The system of claim 14, wherein the quantitative analysis includes determining at least one of a means, deviation, size and shape of disease in the functional image data sets.

15 41. The system of claim 14, wherein the quantitative analysis includes determining at least one of a texture, size and shape of disease in the anatomical image data sets.